

1      **CLAIMS:**

2      1. A method of bonding a first mass to a second mass,  
3 comprising:

4                providing a first mass of first material and a second mass of  
5 second material;

6                joining the first mass and the second mass in physical contact with  
7 one another; and

8                simultaneously diffusion bonding the first mass to the second mass  
9 and developing grains of the second material in the second mass, the  
10 diffusion bonding comprising solid state diffusion between the first mass  
11 and the second mass, a predominate portion of the developed grains  
12 having a maximum dimension of less than 100 microns.

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14      2. The method of claim 1 wherein all of the developed grains  
15 have the maximum dimension of the less than 100 microns.

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17      3. The method of claim 1 wherein the maximum dimension of  
18 the predominate portion of the developed grains is less than or equal  
19 to about 50 microns.

1           4. The method of claim 3 wherein all of the developed grains  
2 have the maximum dimension of the less than or equal to about 50  
3 microns.

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5           5. The method of claim 1 wherein the maximum dimension of  
6 the predominate portion of the developed grains is from about 30  
7 microns to less than 100 microns.

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9           6. The method of claim 5 wherein all of the developed grains  
10 have the maximum dimension of from about 30 microns to less than  
11 100 microns.

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13          7. The method of claim 1 wherein the first material comprises  
14 a same predominate component as the second material.

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16          8. The method of claim 1 wherein the first material comprises  
17 a same predominate element as the second material.

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19          9. The method of claim 1 wherein the bonded first and second  
20 masses correspond to a backing plate and a physical vapor deposition  
21 target, respectively.

1           10. A method of bonding a physical vapor deposition target  
2 material to a backing plate material, comprising:

3           joining the target material and backing plate material in physical  
4 contact with one another; and

5           thermally treating the joined target and backing plate materials to  
6 simultaneously diffusion bond the target material to the backing plate  
7 material and develop grains in the target material, the diffusion bonding  
8 comprising solid state diffusion between the backing plate and target  
9 materials, a predominate portion of the developed grains having a  
10 maximum dimension of less than 100 microns.

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12           11. The method of claim 10 wherein all of the developed grains  
13 have the maximum dimension of the less than 100 microns.

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15           12. The method of claim 10 wherein the maximum dimension of  
16 the predominate portion of the developed grains is less than or equal  
17 to about 50 microns.

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19           13. The method of claim 12 wherein all of the developed grains  
20 have the maximum dimension of the less than or equal to about 50  
21 microns.

1           14. The method of claim 10 wherein the maximum dimension of  
2 the predominate portion of the developed grains is from about 30  
3 microns to less than 100 microns.

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5           15. The method of claim 14 wherein all of the developed grains  
6 have the maximum dimension of from about 30 microns to less than 100  
7 microns.

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9           16. The method of claim 10 wherein the backing plate material  
10 comprises a same predominate component as the target material.

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12          17. The method of claim 10 wherein the backing plate material  
13 comprises a same predominate element as the target material.

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15          18. The method of claim 10 wherein the backing plate material  
16 and target material both predominately comprise aluminum.

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18          19. The method of claim 10 wherein the grain development  
19 comprises recrystallization of grains within the target material.

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21          20. The method of claim 10 wherein the grain development  
22 comprises growth of grains within the target material.

1           21. The method of claim 10 further comprising, before the  
2 joining, work-hardening the target material.

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4           22. The method of claim 10 further comprising, before the  
5 joining, work-hardening the target material by compressing the target  
6 material from an initial thickness to a final thickness, the final thickness  
7 being less than or equal to about 40% of the initial thickness.

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9           23. The method of claim 10 further comprising, before the  
10 joining, work-hardening the target material by compressing the target  
11 material from an initial thickness to a final thickness, the final thickness  
12 being from about 40% to about 2% of the initial thickness.

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14          24. The method of claim 10 further comprising, before the  
15 joining, work-hardening the target material, and wherein the grain  
16 development comprises recrystallization of grains from the work-hardened  
17 material.

1           25. The method of claim 10 further comprising, before the  
2 joining, work-hardening the target material, and wherein the grain  
3 development comprises:

4                   recrystallization of grains from the work-hardened material; and  
5                   growth of the recrystallized grains.

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1           26. A method of forming a physical vapor deposition target  
2 bonded to a backing plate, comprising:

3           joining a physical vapor deposition target material and backing  
4 plate material in physical contact with one another, the physical vapor  
5 deposition target and backing plate materials both comprising aluminum;  
6 and

7           thermally treating the joined physical vapor deposition target and  
8 backing plate materials under an atmosphere which is inert relative to  
9 reaction with the physical vapor deposition target and backing plate  
10 materials, the thermally treating simultaneously diffusion bonding the  
11 physical vapor deposition target material to the backing plate material,  
12 and developing grains in the physical vapor deposition target material,  
13 the diffusion bonding comprising solid state diffusion between the backing  
14 plate material and the physical vapor deposition target material to adhere  
15 the physical vapor deposition target material to the backing plate  
16 material with a bond strength of at least about 5000 pounds/inch<sup>2</sup>, and  
17 a predominate portion of the grains developed in the target material  
18 being less than 100 microns in maximum dimension after the thermally  
19 treating of the target and backing plate materials.

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1           27. The method of claim 26 wherein the backing plate material  
2 and physical vapor deposition target material both predominately comprise  
3 aluminum.

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5           28. The method of claim 26 wherein the grain development  
6 comprises recrystallization of grains within the physical vapor deposition  
7 target material.

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9           29. The method of claim 26 wherein the thermally treating  
10 comprises maintaining the joined physical vapor deposition target material  
11 and backing plate material at a temperature of from about 280°C to  
12 about 400° for a time of from about 20 minutes to about 60 minutes  
13 and pressing the joined physical vapor deposition target and backing  
14 plate materials to a pressure of at least 12,500 pounds/in<sup>2</sup> during at least  
15 part of the time that the temperature is maintained.

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17           30. The method of claim 29 further comprising cooling the  
18 joined physical vapor deposition target and backing plate materials with  
19 a liquid after the temperature treatment.

1           31. The method of claim 29 further comprising cooling the  
2 joined physical vapor deposition target and backing plate materials with  
3 a gas after the temperature treatment.

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5           32. The method of claim 26 wherein the grain development  
6 comprises growth of grains within the physical vapor deposition target  
7 material.

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9           33. The method of claim 26 further comprising, before the  
10 joining, work-hardening the physical vapor deposition target material.

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12          34. The method of claim 26 further comprising, before the  
13 joining, work-hardening the physical vapor deposition target material by  
14 compressing the physical vapor deposition target material from an initial  
15 thickness to a final thickness, the final thickness being less than or equal  
16 to about 40% of the initial thickness.

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18          35. The method of claim 26 further comprising, before the  
19 joining, work-hardening the physical vapor deposition target material by  
20 compressing the physical vapor deposition target material from an initial  
21 thickness to a final thickness, the final thickness being from about 40%  
22 to about 2% of the initial thickness.

1           36. The method of claim 26 further comprising, before the  
2 joining, work-hardening the physical vapor deposition target material, and  
3 wherein the grain development comprises recrystallization of grains from  
4 the work-hardened material.

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6           37. The method of claim 26 further comprising, before the  
7 joining, work-hardening the physical vapor deposition target material, and  
8 wherein the grain development comprises:

9                 recrystallization of grains from the work-hardened material; and  
10                 growth of the recrystallized grains.

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